

What is claimed is:

1. An apparatus for cooling a hot rolled steel strip, the apparatus comprising:

 a transfer means arranged behind a final finishing mill at a manufacturing equipment for a hot rolled steel strip, said transfer means comprising a plurality of transfer rolls located at the specified interval for transferring the hot rolled steel strip;

 at least one upper surface cooling means, arranged at an upper surface side of the transfer means, for cooling the hot rolled steel strip by ejecting cooling water to an upper surface of the hot rolled steel strip;

 at least one lower surface cooling means, arranged at an lower surface side of the transfer means relative to the upper cooling means and the hot rolled steel strip to be transferred, for cooling the hot rolled steel strip by ejecting cooling water to the lower surface of the hot rolled steel strip; and

 said upper surface cooling means, which moves freely up and down and has a water breaking means at least at an outlet side of the cooling apparatus and at a position corresponding to the transfer rolls.

2. The apparatus according to claim 1, wherein said water breaking means comprises water breaking rolls.

3. The apparatus according to claim 1, wherein the upper surface

cooling means and the lower surface cooling means have a flat surface to the hot rolled steel strip.

4. The apparatus according to claim 1, which is either one of at least two cooling apparatus arranged along the transfer means.

5. The apparatus according to claim 2, wherein the water breaking roll has the same peripheral speed as the transfer rolls.

6. The apparatus according to claim 1, wherein the upper surface cooling means and the lower surface cooling means are arranged at the position facing each other through the hot rolled steel strip.

7. A method for cooling a hot rolled steel strip, comprising the steps of:

pinching the upper surface and the lower surface of a hot rolled steel strip by water breaking rolls and transfer rolls behind a final finishing mill of a manufacturing equipment for the hot rolled steel strip when the top end of the steel strip passes through the water breaking rolls and transfer rolls;

cooling the steel strip by ejecting cooling water at the specified condition from upper and lower surfaces of the steel strip with said step of pinching.

8. A method for cooling a hot rolled steel strip, comprising the steps of:

pinching the upper surface and the lower surface of a hot rolled steel strip by water breaking rolls and transfer rolls behind a final finishing mill of a manufacturing equipment for the hot rolled steel strip when the top end of the steel strip passes through the water breaking rolls and transfer rolls;

cooling the steel strip by ejecting cooling water simultaneously with the step of pinching so that a fluid pressure acting to the upper surface of the steel strip and a fluid pressure acting to the lower surface of the steel strip is substantially same.

9. A method for cooling a hot rolled steel strip, comprising the steps of:

pinching a hot rolled steel strip with a water breaking roll and a transfer roll by lowering the water breaking roll to contact the top end of the steel strip with the water breaking roll behind a final finishing mill of a manufacturing equipment for the hot rolled steel strip when the top end of the steel strip passes through the water breaking rolls and transfer rolls, the water breaking roll and the transfer roll having the same peripheral speed;

cooling the steel strip by ejecting cooling water simultaneously with the step of pinching so that a fluid pressure acting to the upper surface of the steel strip and a fluid pressure acting to the lower surface of the steel strip is substantially.

10. An apparatus for cooling a hot rolled steel strip, comprising:

a runout table to transfer a hot rolled steel strip on plural rotating transfer rolls,

a cooling means for cooling the hot rolled steel strip arranged at the runout table, and

a water breaking means arranged just above the transfer roll at the inlet, or outlet, or inlet and outlet of the cooling means in parallel with the transfer roll and with a clearance to the steel strip.

11. The apparatus according to claim 10, wherein the water breaking means is movable up and down.

12. The apparatus according to claim 9, wherein the water breaking means comprises a water breaking roll.

13. The apparatus according to claim 12, wherein the water breaking roll rotates so that the water breaking roll has substantially the same peripheral speed as a transfer speed of the steel strip.

14. The apparatus according to claim 12, further comprising a fluid ejecting means, arranged behind the water breaking roll, for blowing cooling water leaked from a clearance between the water breaking roll and the steel strip toward one side of the steel.

15. A method for cooling a hot rolled steel strip, using the apparatus for cooling the hot rolled steel strip according to claim 11, wherein the water breaking means is raised synchronized with passing of the steel strip top end and/or the water breaking means is lowered raised synchronized with passing of the steel strip bottom end.

16. The apparatus according to claim 15, wherein a clearance between the lowered water breaking means and the steel strip is maintained to be 1 to 10 mm.

17. The apparatus according to claim 10, wherein
said cooling means comprises:

at least one upper surface cooling means, arranged at the upper side of transferred hot rolled steel strip, for ejecting cooling water and cooling the upper surface of the hot rolled steel strip;

at least one lower surface cooling means, arranged at the lower side through the transferred hot rolled steel strip, for ejecting cooling water and cooling the lower surface of the hot rolled steel strip; and

the upper surface cooling means moving freely up and down, the upper surface cooling means having the water breaking means at least at its outlet side and at a position corresponding to the transfer roll.

18. The apparatus according to claim 17, wherein the upper surface cooling means and the lower surface cooling means are nozzles for ejecting cooling water as a laminar flow and a distance from the nozzles to the hot rolled steel strip is 30 to 100 mm.

19. The apparatus according to claim 17, wherein the upper surface cooling means and the lower surface cooling means are arranged facing each other through the hot rolled steel strip.

20. An apparatus for cooling a hot rolled steel strip, comprising:

a transfer means comprising a transfer roll to feed a steel strip which was hot-rolled by a finishing mill;

a cooling means for cooling the steel strip; and

accompanying rolls, arranged with a clearance over thickness of the steel strip at a position where the accompanying rolls face the transfer roll through the steel strip to be transferred, said accompanying rolls rotating at nearly equal peripheral speed to the transfer roll or at the peripheral speed over the transfer speed of the steel strip.

21. The apparatus according to claim 20, further comprising guide plates arranged between each transfer rolls and each accompanying rolls.

22. The apparatus according to claim 21, wherein the cooling means comprises plural cooling nozzles to eject

cooling water; and

the cooling nozzles are arranged at a position where the cooling nozzles faces the guide plate through the steel strip.

23. The apparatus according to claim 20, further comprising a pair of pinch rolls, arranged just ahead of the inlet side of the cooling means, for pinching the steel strip to lead to the cooling means; and

a strip guide, arranged just ahead of the inlet side of the pinch rolls pair, for guiding the steel strip to be transferred to the clearance between the pinch rolls pair.

24. The apparatus according to claim 23, wherein the pair of pinch rolls is arranged at a half way of cooling or just behind the cooling means to pinch the steel strip.

25. An apparatus for cooling a hot rolled steel strip, the apparatus comprising:

a transfer means for transferring a steel strip which was hot rolled at the final finishing mill, said transfer means comprising transfer rolls;

a cooling means for cooling the steel strip; and accompanying rolls, arranged with a clearance over thickness of the steel strip at a position where the accompanying rolls face the transfer roll through the steel strip to be transferred, said accompanying rolls rotating at nearly equal peripheral speed to the transfer roll or at the peripheral speed

over the transfer speed of the steel strip.

26. The apparatus according to claim 25, further comprising guide plates which are arranged between the transfer rolls and between the accompanying rolls.

27. The apparatus according to claim 26, wherein the cooling means comprises plural cooling nozzles to eject cooling water, the plural cooling nozzles being arranged at the specified interval; and
the cooling nozzles are arranged at a position where the cooling nozzles face the guide plate through the steel strip.

28. The apparatus according to claim 25, further comprising a pair of pinch rolls to pinch the steel strip at a position just behind the outlet side of the cooling means.

29. A method for cooling a hot rolled steel strip, comprising the steps of:

transferring a hot rolled steel strip while ejecting cooling water from cooling means at the specified ejecting condition;

pinching a top end of the hot rolled steel strip by a pinching roll, at the inlet and/or just behind the cooling means and/or at a position on the way of cooling;

and

releasing the hot rolled steel strip sequentially from a

pinch roll arranged at upstream side, concurrently with arrival of the steel strip top end to a tension adding means such as a pinch roll or a coiler arranged at downstream side.

30. A method for manufacturing a hot rolled steel strip, comprising the steps of:

heating a slab;

rough rolling the heated slab into a rough rolled bar;

finish rolling the rough rolled bar into a finish rolled steel strip;

cooling the finish rolled steel strip using any one of the cooling apparatus according to claim 1, claims 10 to 14, claims 17 to 28; and

coiling the cooled steel strip.

31. A method for manufacturing a hot rolled steel strip, comprising the steps of:

heating a slab;

rough rolling the heated slab into a rough rolled bar;

finish rolling the rough rolled bar into a finish rolled steel strip;

cooling the finish rolled steel strip using any one of the cooling method according to claims 7 to 9, 15, 16, and 29; and coiling the cooled steel strip.